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TEST PLANS AND PROCEDURES

FOR THE

BASELINE SAF FOR BDS-D SITES

(ModSAF)

VOLUME 1 of 2

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This document provides formal test procedures for acceptance of the ModSAF system. The test procedures verify that the requirements of the ModSAF system have been met.

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1. SCOPE

This Acceptance Test Plan (ATP) establishes the plan for the testing of the Baseline Modular Semi-Automated Forces (ModSAF) for Battlefield Distributed Simulation - Developmental (BDS-D) sites. This document has been developed by LORAL Advanced Distributed Simulation under contract Number N61339-91-D-0001; D.O. 0021, Contract Data Requirements List (CDRL) A006, in accordance with paragraph 3.3 of the Statement of Work (SOW), Baseline SAF for BDS-D Sites, ModSAF.

1.1 System Overview

The purpose of the ModSAF environment is to provide a Distributed Interactive Simulation (DIS) system for simulating and controlling entities, such as vehicles, Dismounted Infantry (DI), missiles, and dynamic structures on a virtual battlefield. These entities interact with each other and with manned individual entity simulators, such as an M1 tank simulator, to support training, combat development experiments, tactics and doctrine studies, weapon and sensor evaluations, and man-machine interface issues. The ModSAF System functions in an established simulation system environment at the Aviation Test Bed (AVTB) at Ft. Rucker, Alabama, and the Mounted Warfare Test Bed (MWTB) at Ft. Knox, Kentucky. The purpose of this test plan is to define the test program which will verify the requirements and operation of the ModSAF System after integration with the existing facilities. Figure 1.0-1 reflects the components of the ModSAF environment which are applicable to the ModSAF delivery order. Once the testing of the ModSAF software has been completed and the software and documentation referred to as ModSAF 1.0 has been accepted by and delivered to the Government, configuration management will be established. It is anticipated the ModSAF software and documentation will be delivered to multiple Government and industry sites.

ModSAF comes from the Advanced Research Projects Agency (ARPA) What If Simulation System for Advanced Research and Development (WISSARD) and "Seamless Simulation" programs. ModSAF restructures the SAFOR baseline to make if more open, more modular and DIS compliant. In addition to new functionality developed under WISSARD, ModSAF 1.0 focuses on providing better control, more flexibility and extensions to higher echelons, and full documentation of the ModSAF 1.0 SAFOR.

With ModSAF, the operator is able to organize forces according to task, transfer control to another operator, and regroup forces for new tasks. A single operator has the ability to command vehicles simulated by more than one SAFOR workstation. It is also possible to checkpoint and restart a mission without re-tasking the forces. Command and control information is recorded along with exercise information. The system provides beyond visual range air-to-air combat behavior, and includes improved modeling of radar, intervisibility among entities, and detection probabilities. The operator can plan higher level and more flexible missions by including contingencies for

known and expected agents. The resulting ModSAF runs under DIS 1.0 protocol standards.

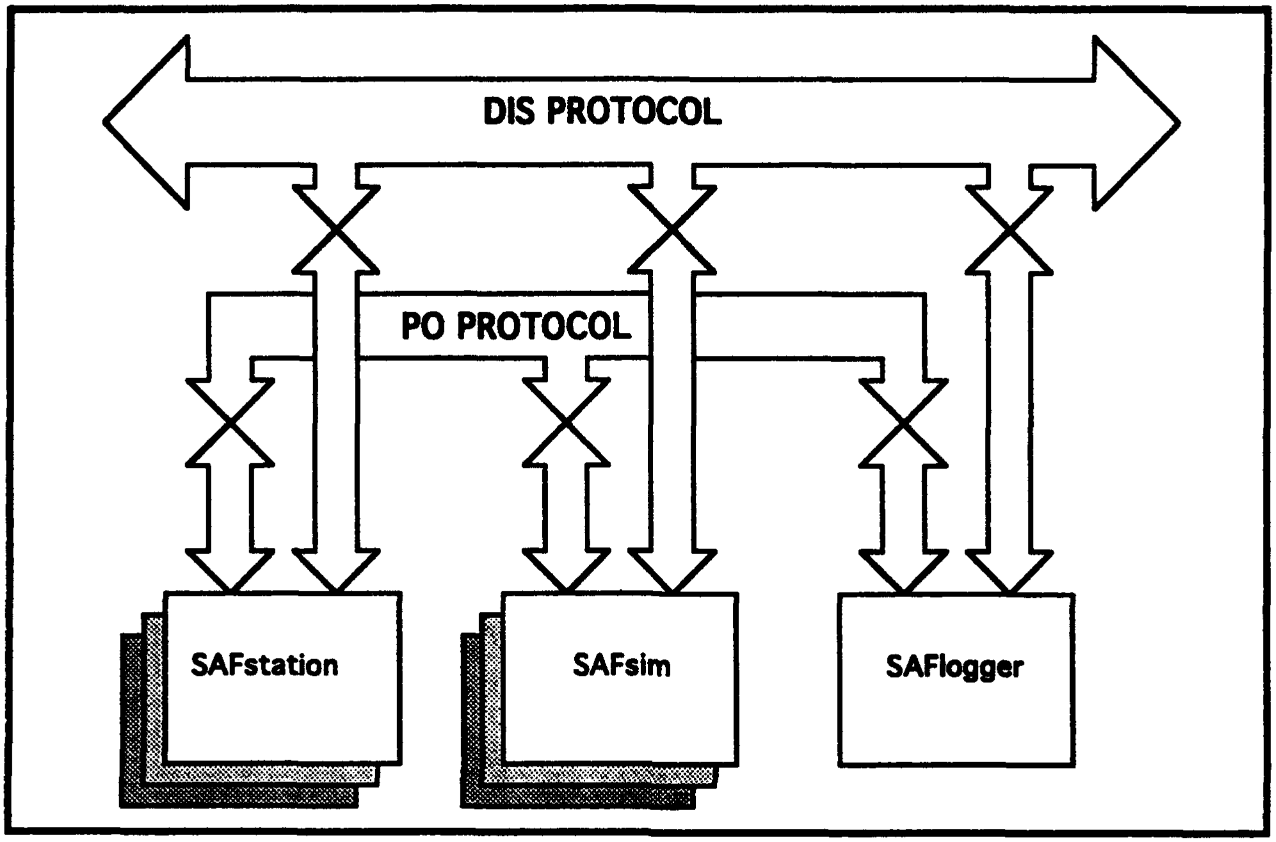

Figure 1.0-1 <u>ModSAF Environment</u>

The objectives of the ModSAF 1.0 delivery order for which this Acceptance Test Plan applies are as follows:

- To bring SAFOR systems, both hardware and software, to a common baseline, with documentation and training sufficient to permit BDS-D site personnel to maintain the upgraded systems.
- To provide additional capabilities including new battlefield platforms and functionality, SAFOR operator tools, and better system performance.
- To provide all of the capabilities of the SAFOR in use at the sites at the time of installation of the ModSAF System.
- To provide for a graceful transition path from ModSAF to Computer Generated Forces (CGF).

The purpose of this ATP is to provide formal test procedures for acceptance of the ModSAF System. The test procedures verify that the requirements of the ModSAF System have been met. These procedures do not verify and validate the software models of individual entities.

1.2 Document Overview

This Acceptance Test Plan is organized into two volumes to satisfy the CDRL A006 requirement. Each volume is a stand-alone document and consists of the following sections:

1. Volume I - This Volume of the Acceptance Test Plan details the test definitions and test philosophy for the ModSAF 1.0 System test program. The following sections constitute this volume:
   a. Section 1 contains an overview, purpose and brief description of the functionality of the ModSAF System environment.
   b. Section 2 identifies those documents which are applicable and have been referenced in the generation of this document.
   c. Section 3 provides the test philosophy and approach to be implemented in the verification of the ModSAF System requirements and design. The tests described in this section will be the basis for the generation of the Volume II document.
   d. Appendix A - ModSAF Requirements Traceability Matrix.
   e. Appendix B - Glossary of Acronyms and Abbreviations.

2. Volume II - This volume of the Acceptance Test Plan contains qualification test preparations, pre-test procedures, qualification test descriptions, and identification of test cases. Finally, the volume contains the detailed step-by-step procedures to verify the ModSAF System requirements as defined in the ModSAF 1.0 System Requirements Specification document. The allocation of requirements to each test are provided in Appendix A of Volume I and will provide the traceability to the procedures contained in this volume.

2.0 APPLICABLE DOCUMENTS

The following documents are applicable to the extent referenced herein and where not specifically referenced are used as sources of additional information.

1. ModSAF Systems Requirement Specification, STRICOM, 12350 Research Parkway, Orlando, Florida 32826-3275, dated 15 February 1993.
2. Statement of Work for the Baseline SAF for BDS-D Sites, Modular Semi-Automated Forces (ModSAF), dated 10 October 1992.
3. ModSAF Installation Plan, STRICOM, 12350 Research Parkway, Orlando, Florida 32826-3275, dated 12 February 1993.
4. ModSAF Training Plan, STRICOM, 12350 Research Parkway, Orlando, Florida 32826-3275, dated 12 February 1993.
5. ModSAF Maintenance Plan, STRICOM, 12350 Research Parkway, Orlando, Florida 32826-3275, dated 12 February 1993.

3.0 TEST PHILOSOPHY AND OBJECTIVES

The ModSAF System test philosophy is to verify as many of the requirements as possible during the early stages of the testing program. This approach to final acceptance will provide the benefits of surfacing problems early in the testing program which will also enable early resolutions of the problems. This approach also provides the benefit of a smooth on-site acceptance test phase in that the acceptance test procedures will have been previously exercised and procedural problems corrected as applicable. The early stages of the testing program defined as the In-House Verification test phase, will be conducted in the Loral Advanced Distributed Simulations (LADS) facility located in Cambridge, Massachusetts. A government-owned IRIS INDIGO system will be configured to support the testing of the requirements associated with the ModSAF System.

A ModSAF Requirements Traceability Matrix will be maintained throughout all testing phases which will provide the status of requirements verified, or failed, as applicable. In addition to the Requirements Traceability Matrix, a Software Problem Report (SPR) system will be maintained for all problems surfaced during the test program. The Requirements Traceability Matrix will be maintained in such a manner that the SPRs are completely traceable to the requirements affected. As each SPR is generated, assignment will be made by the ModSAF System delivery order manager, or his designated representative, as to whether the problem is procedural, hardware, software, or a system problem. Accordingly, appropriate personnel will be assigned to investigate and resolve the problem. As problems are resolved, they will be submitted for re-test before becoming part of the "next" official baseline. An important part of the ModSAF System test program will be "regression" testing. Continuous regression testing will be conducted throughout the test program to ensure that as new resolutions

are introduced into the baseline, previously working functions have not been contaminated.

The primary objective of this plan and the accompanying test procedures (Vol II) is to establish that the ModSAF System is in compliance with the requirements as delineated in the ModSAF System Requirements document. This objective is best achieved by defining tests, development of test procedures, and execution of these tests which will thoroughly verify the ModSAF System requirements.

3.1 Test Description

The ModSAF System is comprised of four subsystems that will be tested. The subsystems are identified as follows:

- SAF Workstation Subsystem
- SAF Simulator Subsystem
- SAF Logger Subsystem
- ModSAF Interface

In addition, the test program will verify aggregate requirements.

The test program will develop test procedures with the objective of verifying the aggregate requirements and the specific requirements pertaining to each of the defined subsystems. The definition of tests and allocation of requirements will be made to provide a most efficient and thorough test program. This will be accomplished through analysis of the requirements and existing design documentation so that the requirements can be correlated to the functionality of the subject requirements. Independent tests and procedures will be defined so that these tests can be executed independently. The independent test approach will provide the program with the flexibility to execute the tests in any sequence desired and remove dependencies where execution of functions are truly independent. The ModSAF Requirements Traceability Matrix (Appendix A) identifies the allocation of requirements to the tests as defined in the following paragraphs:

<u>3.1.1 ModSAF System Overall Requirements</u>

This test will verify the overall functional requirements of the ModSAF 1.0 System. Among the many capabilities that will be tested or demonstrated in this test as part of the ModSAF 1.0 System Overall Requirements are:

- Architecture.
- Configurations.
- Top Level Requirements.
- Versions.
- Testability.

- Extensibility.
- Documentation.

This test will verify:

1) the architecture and distribution of the capabilities of ModSAF among three components,
2) sharing of simulation and control information by using databases and network protocols,
3) single and combined system operation,
4) control of simulated entities by single and multiple SAFstations,
5) creation of large numbers of computer generated DIS forces,
6) capabilities that equal or exceed those of the currently fielded SAFOR systems,
7) Version 1.0 requirements,
8) testability of operations under successively simpler conditions,
9) library and parameter file extensibility, and
10) availability of ModSAF documentation.

3.1.2 SAF Workstation Subsystem

This subsystem test will demonstrate the capabilities associated with the SAF Workstation Subsystem. Conditions will be set up to ensure verification of the following capabilities:

- Mode Control.
- Plan View Display.
- Exercise Initialization Parameters.
- Exercise Control Parameters.
- Scenario Storage.
- Force Control.
- Interaction Between Workstations.
- Databases.
- Standards.

This test will verify the functional requirements for the ModSAF workstation. This test will verify:

1) support of three operator privilege modes,
2) a two-dimensional view of the simulated environment including control tools,
3) parameter control for an exercise,
4) saving of all mission and unit information into a scenario file,
5) control of ModSAF entities and units,
6) parameter initialization for an exercise,
7) control of aspects of the user interface,
8) ability to interact with other workstations,
9) access to the numerous databases, and

10) use of X/Windows Motif standards and DOD Human Computer Interface Style Guide.

3.1.3 SAF Simulator Subsystem

This subsystem test will demonstrate the capabilities associated with the SAF Simulator Subsystem. Conditions will be set up to ensure verification of the following capabilities:

- Exercise Control.
- Command Interface.
- Entity Simulation.
- Structure Simulation.
- Unit Simulation.
- Parser Interface.
- Database Interfaces.

This test will verify the functional requirements for the SAFsim component of ModSAF. This subsystem will verify:

1) entity creation, state update, deletion and migration,
2) monitoring of PO database for entity actions,
3) construction of new entities either off-line by changing parameter files, or at run time via the PO database,
4) simulation of structures on the terrain,
5) unit simulation including combinations of entities, or entities and units,
6) parser interface for SAF software testing, and
7) database interfaces.

3.1.4 SAF Logger Subsystem

This subsystem test will demonstrate the capabilities associated with the SAF Logger Subsystem. Conditions will be set up to ensure verification of the following capabilities:

- Graphical User Interface (GUI).
- Exercise Recording.
- Exercise Playback.
- Initialization of ModSAF from a Logged Exercise.

This test will verify the functional requirements for the ModSAF data logger. This test will verify:

1) record and play back of simulation exercises,
2) creation of initialization overlays,
3) use of graphical user interface for user interaction,
4) recording of the simulation packets of any protocol family transmitted on the simulation network,

5) playback of the simulation packets of any protocol family recorded in a ModSAF data logger file, and
6) initialization of ModSAF from any point in a logged exercise using the recorded PO protocol packets.

3.1.5 ModSAF Interface

This test will demonstrate the capabilities associated with the Interface Requirements. Conditions will be set up to ensure verification of the following capabilities:

- DIS Database Interface.
- PO Database Interface.
- Parameter Database Interface.
- Terrain Database Interface.

This test will verify the interfacing of ModSAF components via the DIS database, PO database, parameter database, and the terrain database. This test will verify:

1) the support of DIS 1.0 protocol, with appropriate extensions,
2) the support of SIMNET 6.6.1 protocol,
3) PO database support, including organization of command and control information as shared overlays,
4) ability to modify the parameter database to define entity characteristics, and
5) terrain database queries and modifications.

APPENDIX A

Requirements Traceability Matrix

Test Methodologies:

I=Inspection—Verification by visual examination of the displays, reviewing descriptive documentation, and comparing the appropriate characteristics with a reference standard, to determine conformance to requirements. This includes mechanical inspection of equipment and the verification of accuracy and completeness of the documentation.

A=Analysis—Verification by evaluation using data sheets gathered from test participants, mathematical representations, charts, graphs, or data reduction to determine conformance to requirements.

D=Demonstration—Verification by operation, movement, or adjustment of the item under specific conditions to perform the designed function to determine conformance to the requirements. This includes content and accuracy of displays, and prompt system recovery from induced failure conditions.

R=Reliability-Not verified by Demonstration or Test. Verified as the byproduct of reliability and documentation testing by *ILS* personnel and/or engineering resources.

T=Test—Verification through systematic exercising of the applicable items under appropriate conditions, with instrumentation and collection, analysis, and evaluation of quantitative data to determine conformance to requirements. This includes correct computer program control flow, correct computer program data flow, and acceptance of proper range of values.

PARA	TITLE	DESCRIPTION	METH	TEST
1.1	Architecture	The capabilities of ModSAF will be distributed among these three components: SAFstation, SAFsim, SAF-logger.	I	
1.1		The ModSAF components will share simulation and control information by using the databases and network protocols described below: DIS Database, Persistent Object (PO) Database, Terrain Databases, and Parameter Database.	I	
1.2	Configur-ations	A single computer will be able to run one of the SAFstation, SAFsim, or SAF-logger components at a time.	D	
1.2		A single computer will be able to run both the SAFstation and SAFsim at the same time.	D	
1.2		Multiple SAFstations will be able to control entities simulated by one SAFsim.	D	
1.2		One SAFstation will be able to control entities simulated on multiple SAFsims.	D	
1.2		The SAFsims will act as simulation servers and will negotiate between themselves which SAFsim should simulate an entity, unless one SAFsim has been specifically designated.	D	
1.2		The SAFsim will not have to connect to a SAFsim but will communicate with all SAFsims via the Persistent Object Database.	D	
1.2		One SAFstation will be able to initialize and load a scenario on all the SAF components participating in the exercise.	D	
1.3	Top Level Requirements	ModSAF will provide the capability to create large numbers of computer generated DIS forces that can be controlled by small numbers of operators providing supervisory control.	D	
1.3		It will provide capabilities that equal or exceed those of the currently fielded SAFOR systems: SIMNET SAF 3.11.2 and ODIN SAF 4.3.6.	I	
1.3		ModSAF will provide support for the WISSARD project, including interfaces for control by the SOAR artificial intelligence reasoning system.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
1.3		The ModSAF software will be capable of running on MIPS and SGI computers.	D	
1.4	Versions	ModSAF will be delivered in incremental versions: ModSAF A, ModSAF B, ModSAF 1.0, ModSAF 2.0.	D	
1.5	Testability	The ModSAF software will be constructed so that it is possible to test its operation under successively simpler conditions.	I	
1.5		There will be mechanisms by which complicating factors such as communications failures, occlusion, collisions, random failures, etc., can be eliminated.	I	
1.6	Extensibility	The ModSAF system architecture will provide extensibility through the use of libraries and a parameter database.	I	
1.6.1	Libraries	ModSAF software will be organized into libraries, with applications built from these libraries.	I	
1.6.1		The libraries will be layered so that libraries only depend on other libraries at a lower level.	I	
1.6.1		All libraries will define public interfaces (exported routines and header files).	I	
1.6.1		All other routines will be declared static.	I	
1.6.2	Parameter Files	ModSAF will parameterize both behavioral and physical models so that a variety of physical systems can be represented.	I	
1.6.2		At program startup time, the off-line parameter database which defines these parameters will be translated into a runtime database.	I	
1.6.2		During runtime, the user or the system will be allowed to change this database for the purpose of making changes to models without forcing a recompilation of source code.	I	
1.7	Documentation	ModSAF documentation will be available in both hardcopy and on-line format on the ModSAF development computers.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
1.7		ModSAF documentation will include: Requirements Document, Interface Description Document, Library Documentation, User's Manual, Installation Instructions, and Maintenance Plan.	I	
2.1	Mode Control	The SAFstation will support three operator privilege modes.	D	
2.1		The highest privilege mode, System Operator, will provide more functionality than the lower two privilege modes, Battlemaster and Commander.	D	
2.1	SAF Workstation Requirements	This ModSAF component will allow a user to set up, view, control, and participate in DIS exercises.	D	
2.1		The middle privilege mode, Battlemaster, will provide more functionality than the lowest privilege mode, Commander.	D	
2.1.1	Commander Mode	Commander mode will provide the ability to run a pre-load scenario and to command the commanders' SAF entities in that scenario.	D	
2.1.1		In Commander mode, the situation display will show only the entities on the same side as the entities controlled by the commander, and any enemy entities detected by the commander's entities.	D	
2.1.2	Battlemaster Mode	In Battlemaster mode, the SAF operator will be able to create and save scenarios, in addition to having all the capabilities provided in Commander mode.	D	
2.1.3	System Operator Mode	System Operator mode will allow the SAF operator to perform file operations such as delete and save, in addition to providing all the functionality of Battlemaster mode.	D	
2.1.3		In System Operator mode, the SAF operator will have the ability to set all passwords and modify the simulation configurations.	D	
2.2	Plan View Display	The SAFstation will provide a two-dimensional view of the simulated environment (the so-called Plan View Display), along with various tools for controlling the view onto the environment and determining which features are displayed in it.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.2.1	Controlling the Display	The SAFstation operator will be able to control the view of the simulated environment as described below.	D	
2.2.1.1	Panning	The SAFstation will provide the ability for the operator to pan, that is, to select any portion of the map for display.	D	
2.2.1.1		The operator will be able to pan by using scroll bars, by dragging a viewing window with the mouse, or by clicking with the mouse on a new map center.	D	
2.2.1.2	Changing the Scale	A Scale menu will allow the operator to change the scale of the tactical map display.	D	
2.2.1.2		The Scale menu will display the current scale and provide the ability to select a different scale.	D	
2.2.1.2		The operator will be able to choose whether the map scale is restricted to standard map scales or can be freely adjusted.	D	
2.2.1.3	Zooming In and Out	The SAFstation will allow the operator to zoom in on a small portion of the tactical map or zoom out to a large portion by clicking once with the mouse on the map.	D	
2.2.1.3		The SAFstation will allow the operator to use the mouse to select a rectangular area to zoom in upon.	D	
2.2.2	Displaying the Terrain	The SAFstation will allow the operator to determine which terrain features are currently displayed (roads, trees, lakes, etc.).	D	
2.2.2		It will allow the operator to select the terrain features displayed, the elevation presentation (by shaded relief, hypsometric tinting, or contour lines), and which military grid system, if any, to use.	D	
2.2.2.1	Features	The terrain features available for display on the tactical map display will include, but not be limited to roads, trees, tree canopies, rivers, lakes, buildings, railroads, pipelines, and power lines.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.2.2.2	Elevation	The operator will be able to display elevation by the following two methods: hypsometric tinting and contour lines.	D	
2.2.2.2		The operator will be able to display elevation by colors.	D	
2.2.2.2		A legend will specify the elevation range of each color.	D	
2.2.2.2		The operator will be able to display elevation by contour lines with or without labels showing the elevation values.	D	
2.2.2.2		The operator will be able to set the contour interval at any time, from 5 to 40 meters, in increments of 5 meters.	D	
2.2.2.2		The interval selected will be displayed.	D	
2.2.2.3	Military Grids	The SAFstation operator will be able to overlay a grid system on the map in either longitude/latitude or UTM form.	D	
2.2.2.3		The grids will be shown at a scale appropriate for the current map scale.	D	
2.2.2.3		At the 1:200,000 map scale, one-digit UTM grids will be shown, while at the 1:50,000 map scale, two-digit UTM grids will be shown.	D	
2.2.3	Analyzing the Terrain	The SAFstation will provide the following tools to allow the SAF operator to analyze the current terrain database: terrain ruler, cross-section tool, intervisibility tools, terrain query tool and coordinate calculator.	D	
2.2.3.1	Terrain Ruler	A terrain ruler will allow the operator to measure distances on the map.	D	
2.2.3.1		The operator will have the ability to specify the units in which the distance is measured.	D	
2.2.3.1		The direction of the ruler will be displayed.	D	
2.2.3.2	Cross-Section Tool	A terrain cross-section tool will allow the operator to display the difference in elevation between two terrain points specified by the operator.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.2.3.2		The length and direction of the cross-section line drawn between the specified points will be displayed; the composition of the terrain will not.	D	
2.2.3.3	Inter-visibility Tool	Inter-visibility tools will allow the operator to do the following: (1) check the inter-visibility between individual entities, (2) check the inter-visibility between points on the terrain, and (3) check the area inter-visibility around a location.	D	
2.2.3.3		The operator will be able to specify how high above the terrain the inter-visibility is measured.	D	
2.2.3.3		For air vehicles, the altitude of the vehicle will be used as the height at which the inter-visibility is measured.	D	
2.2.3.3		For ground entities, the elevation of the commander or driver will be used as the height at which the inter-visibility is measured.	D	
2.2.3.3		The operator will be able to set the range for area inter-visibility plots.	D	
2.2.3.4	Terrain Query Tool	The operator will be able to query the tactical map at any location to determine the soil type (RCI250, road, water, etc.), elevation, maximum gradient, and location.	D	
2.2.3.5	Coordinate Calculator	A coordinate calculator will allow the SAF operator to select a point on the map and calculate its location in earth centered Cartesian, UTM, longitude/latitude, and topocentric Cartesian coordinates.	D	
2.2.4	Displaying the Situation	The Plan View Display will be able to show the current situation in an exercise by displaying the current positions of all entities involved in the exercise.	D	
2.2.4		It will be possible to use the parameter files described in Chapter 5 to change the icons used to denote units and entities, or to add new icons.	D	
2.2.4		The operator will be able to specify the refresh rate of the entity icons on the situation display, from 1 to 120 seconds.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.2.4		The operator will also be able to temporarily freeze entity icon updates.	D	
2.2.4.1	Military Units	Army symbology and Navy symbology will be used to display military units.	I	
2.2.4.1		The operator will be able to choose which symbology takes precedence when both are applicable.	I	
2.2.4.1		The Army symbology will be defined by "FM 101-5: Operational Terms and Graphics.	I	
2.2.4.1		It will be possible to query the unit icons to get a description of the unit they represent.	D	
2.2.4.1		This description will include the entity ID and designation for the unit.	D	
2.2.4.1		It will be possible to aggregate the display to show only higher-level units or deaggregate it to show individual entities.	D	
2.2.4.1		Aggregation/deaggregation will be possible either globally or for individual units.	D	
2.2.4.1		Filters will allow the operator to control the display of different force types, including armor, infantry, artillery, air defense, support, air assets, and sea assets.	D	
2.2.4.1		A filter will allow control of whether the operator can see what all of his forces can see, or only what some subset of his forces can see.	D	
2.2.4.2	Entities	Individual entities may be displayed by the standard military symbology of "FM 101-5: Operational Terms and Graphics," or they may be displayed in a non-military form.	D	
2.2.4.2		The standard military form will show entity direction quantized to 8 directions (45 degrees), while the non-military form will show exact entity and turret orientations.	D	
2.2.4.2		Both forms will show catastrophic entity damage.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.2.4.2		The SAFstation will provide the ability to increase and decrease the drawing size of the non-military entity symbols.	D	
2.2.4.2		It will be possible to query the entity icons to get a description of the entities they represent.	D	
2.2.4.2		This description will include the entity ID and designation for the entity and, if the entity is being controlled by the SAFstation making the query, the current status of that entity, including information about fuel and ammunition supplies, speed, mission status, and damage level.	D	
2.2.4.2		It will be possible to display inter-visibility lines between entities.	D	
2.2.4.2		When an entity is only partially visible, the percentage that is visible will be indicated by the color of the intervisibility line and by text field showing the percentage.	D	
2.2.4.3	Designations	The SAF operator will be able to specify designations for units and entities and specify whether to display these designations.	D	
2.2.4.3		If the SAF operator does not specify a designation for an entity or unit, ModSAF will supply a default designation.	D	
2.2.4.4	Simulation Events	The SAFstation will display simulation events such as indirect fire explosions.	D	
2.2.4.4		The SAFstation will also display direct fire, designating the target and firer and whether the shot was a hit or a miss.	D	
2.2.4.4		The SAFstation will also display minefield explosions.	D	
2.3	Exercise Initializ-ation Parameters	Any SAFstation will be able to initialize the parameters for an exercise.	D	
2.3		The exercise initialization functions will be available only in Battlemaster and/or the System Operator modes.	D	
2.3		When the System Operator sets the terrain database for the exercise, all workstations and simulators will change to the selected terrain.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.3		Changing the terrain will cause running simulations to stop.	D	
2.4	Exercise Control Parameters	Any SAFstation will be able to control the parameters for an exercise.	D	
2.4		The exercise control functions will be available only in Battlemaster mode.	D	
2.4		Parameters that can be controlled will include minefields, artillery, and model parameters.	D	
2.4.1	Minefields	The Battlemaster will be able to create minefields from the SAFstation at any time.	D	
2.4.1		The Battlemaster will be able to draw the bounding area of the minefield and then request simulation of the minefield from the SAFsim.	D	
2.4.1		He will be able to specify minefield parameters such as density and type of mine.	D	
2.4.2	Artillery	The Battlemaster will be able to interactively create artillery bursts in any location or area on the terrain.		N/I
2.4.2		Various options will be available, such as number of rounds, dispersal pattern and distance, rate, round types, and time delays between rounds.		N/I
2.4.2		Bombs, mortars, howitzers, and MLRS will be available.		N/I
2.4.2		Timed/proximity and contact fuses will be available.		N/I
2.4.2		It will be possible to set up multiple missions so that artillery can fall at a specified time during an exercise.		N/I
2.4.3	Model Parameters	The SAFstation will provide the ability to modify simulation modeling parameters in real time.	I	
2.4.3		It will be possible to apply a single set of parameter changes to multiple SAF units without duplicate data entry.	I	
2.5	Scenario Storage	The ModSAF system will all the Battlemaster to save all mission and unit information into a scenario file.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.5		This file will contain information about all entities, units, unit hiearchies, missions, tasks, control measures, and artillery scripts that are currently controlled by the workstation or that were created by it.	D	
2.5		This file will allow a new exercise to be initialized at the point at which the previous exercise was saved.	D	
2.6	Force Control	The operator will be able to give orders to any unit or entity directly by clicking on its icon.	D	
2.6.1	Task Organization	The operator will be able to create and command units from the battalion level down to the individual entity level.		N/I
2.6.1		It will be possible for the operator to create new tactical organizations on line, using the standard graphical user interface, without modification to the underlying software.		N/I
2.6.1		It will be possible to use the new task organizations in the standard command and control mechanism.		N/I
2.6.1		The units will be built up in a hierarchical and modular way, allowing the operator to mix branches (e.g., armor, close air support, artillery, and infantry) and equipment nationalities (e.g., US armor vehicles with Russian armor vehicles).		N/I
2.6.1		Formations and movement techniques will be defined in a similarly modular way, so that they will work with the task-organized units.		N/I
2.6.1		It will be possible to save the task organizations to a data file for reuse in other scenarios.		N/I
2.6.1		It will be possible to construct formations, movement techniques, and missions in a hierarchical manner.		N/I
2.6.2	Methods of Control	Three methods of control will be available to the operator: pre-programmed, immediate, and reactive.	D	
2.6.2		Pre-programmed and immediate control will be available to the operator at any time.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.6.2		The operator will be able to specify the contingencies to which the units will react and how the units will react to them.	D	
2.6.2.1	Pre-programmed Control	Pre-programmed control will support the definition of missions in terms of the following: (1) the units that perform them, (2) control measures (such as phase lines, travel routes, point, and assembly areas), (3) conditions under which to terminate or transition between mission phases.	D	
2.6.2.1		The conditions for transitioning between mission phases will be definable in terms of the following: (1) terrain, (2) time, and (3) situation.	D	
2.6.2.1		The operator will be able to construct any logical combination (using AND, OR, and NOT) of these basic or composite conditions as a composite condition upon which to terminate or transition mission phases.	D	
2.6.2.1		The operator will be able to specify several contingency missions for any given unit and select the one mode appropriate to the developing tactical situation.	D	
2.6.2.1		It will be possible to modify predefined missions during an exercise, or to define and execute entirely new ones.	D	
2.6.2.1		The operator will be able to define, store, and reuse missions with predefined conditions under which to automatically execute various contingencies.	D	
2.6.2.1		Once the overall mission is begun, the contingencies will be automatically selected and executed, using the kinds of conditions discussed above.	D	
2.6.2.1		It will be possible for the operator to issue commands to a subordinate unit while the superior unit is executing its mission.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.6.2.1		Without further operator interventions, the subordinate unit will perform its mission, while the senior unit adjusts its formations and actions in tactically realistic ways to accommodate the loss of the subordinate unit.	D	
2.6.2.1		The subordinate unit will rejoin its superior unit after its temporary mission is completed.	D	
2.6.2.1		The operator will be able to specify tasks that specify movement of units along a single path, as well as tasks that specify movement of units along different paths.	D	
2.6.2.1		Within each mission or mission phase, the operator will be able to redefine behavior and capability parameters for the unit or entity.	D	
2.6.2.1		Parameters controlled will include at least the following: speed, formation, orientation, fire permission, marksmanship, target priorities, fuel consumption rates, priorities for different simultaneous objectives (such as finding the enemy, avoiding detection, moving rapidly, and surviving), task, and entity parameters (such as vulnerability, turn radii, sensor capabilities, speed and acceleration limits, and weapons capabilities).	D	
2.6.2.2	Immediate Control	Immediate control will allow the operator to give commands interactively to override either pre-programmed or reactive behaviors.	D	
2.6.2.2		The operator will have the option of either overriding previous commands or temporarily suspending them until the immediate command is completed.	D	
2.6.2.2		Parameters under immediate control will include at least the following: speed, formation, orientation, fire permission, marksmanship, target priorities, and task.	D	
2.6.2.3	Reactive Control	The operator will be able to specify the reactive behavior of units.		

PARA	TITLE	DESCRIPTION	METH	TEST
2.6.2.3		This will be accomplished by allowing the operator to select a set of situations and battlefield events to which the units will respond (e.g., artillery attack), modify the parameters of those situations and events (e.g., artillery has fallen within 1 km of the unit), and specify the unit's reaction to each situation or event (e.g., withdraw 5 km away from the artillery bursts).	D	
2.6.3	Mission Graphics	The SAFstation will provide graphical symbols for the planning of missions.	I	
2.6.3.1	Overlays	The SAFstation operator will be able to create tactical overlays by arranging ModSAF graphics.	D	
2.6.3.1		The SAFstation operator will be able to edit, save, load, and delete these overlays.	D	
2.6.3.1		Overlays can be shared between SAFstations, although controls will be placed on which workstations can share overlays (based on which side the workstations are playing in an exercise).	D	
2.6.3.1		The SAFstation will provide the capability to show or hide specific overlays to allow the operator to superimpose graphics on the tactical display.	D	
2.6.3.2	Graphical Control Measures	The SAFstation will be able to create and edit the following graphical control measures: routes, points, lines, areas and zones, and text.	D	
2.6.3.2		Routes -- The SAFstation will provide the ability to create routes for SAF entities to follow during missions, including circular routes.	D	
2.6.3.2		The SAFstation operator will be able to create, edit, and delete routes.	D	
2.6.3.2		In addition, the ability to add points to the end of a route will be provided.	D	
2.6.3.2		The following types of routes will be supported: air, road, cross-country, and bridge.	D	
2.6.3.2		Air routes -- will insert straight line routes between operator-specified points.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.6.3.2		Road routes -- will determine the shortest sequence of road segments between operator-specified road points.	D	
2.6.3.2		Cross-country routes -- will check for water crossings and allow the operator to have the route modified to avoid the water.	D	
2.6.3.2		Bridge routes -- will allow the operator to select a bridge to cross as part of a cross-country route.	D	
2.6.3.2		Points -- The SAFstation operator will be able to place the following types of points: general, coordinating, contact, control, target reference, fortification, decision, hide, and launch points.	D	
2.6.3.2		Lines -- The SAFstation operator will be able to place the following types of lines: plain, front, minefield, fortification, berm, antitank ditch, and wire. Lines can be used to define other military control measures, such as unit boundaries, objectives, and phase lines.	D	
2.6.3.2		Areas and zones -- The SAFstation operator will be able to place areas and zones. These can be used to define assembly areas, battle positions, and other military area control measures.	D	
2.6.3.2		Text -- The SAFstation operator will be able to place multiple lines of text on the display.	D	
2.6.3.2		These control measures can be used in the mission specifications for units and entities. Various colors will be provided for each control measure type, including black, yellow, red, green, and blue. Solid or dashed lines can be used for all line, area, and zone control measures.	D	
2.6.3.2		The operator will be able to move any control measure as a whole or move any of the individual points that define a control measure. The operator can add points to and delete points from any control measure or delete it entirely. The operator can add labels to control measures and edit the labels.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.6.4	Message Log	The SAFstation will provide a message log that will display status messages and reports from the simulated entities and units under its control.	D	
2.6.4		A radio log will show orders issued to the simulated entities and units from that SAFstation.	D	
2.6.4		The operator can control the frequency with which messages are sent, and which reports are sent.	D	
2.6.5	H-Hour Time	The SAFstation will provide the ability to set an H-Hour Time, so that all SAF entities can perform coordinating actions.		N/I
2.6.5		This H-Hour time can be modified, and it can be shared among workstations fighting on the same side.		N/I
2.6.6	Resupply	The SAFstation will provide a method for setting the fuel levels and weapons loads of entities at resupply locations.		N/I
2.6.6		Airport locations for fixed-wing aircraft and FARP locations for rotary-wing aircraft must be specified by the Battlemaster. The airport locations can be on or off the terrain database.		N/I
2.6.6		The resupply locations can be shared among SAFstations and can be saved in overlays.		N/I
2.6.6		Ground entities will be resupplied through logistics vehicles in the simulation.		N/I
2.6.6		The Battlemaster will be able to resupply any SAF unit or entity at anytime.		N/I
2.6.7	SAFview Controls	The SAFstation operator will be able to perform the following operations with any SAFview component or Stealth (Flying Carpet) on the simulation network: (1) Teleport the SAFview to any location on the database and (2) Attach the SAFview to any entity under his command, using a number of attachment modes.	D	
2.6.7		These operations may be used to control other three-dimensional displays, such as the ODIN Flying Carpet.	D	
2.6.7		The use of the SAFview will be restricted in Commander mode.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.6.7		When the SAFview is not integrated with another ModSAF application, the operator will be able to change the exercise ID of the SAFview.	D	
2.6.7		When the SAFview is integrated, it will use the exercise ID selected for the application.	D	
2.6.7		The current velocity and direction of travel of the SAFview will be displayed.	D	
2.6.7		An icon on the situation display will indicate the location and viewing direction of each SAFview on the network.	D	
2.6.8	Vehicle Status Panel	The SAFstation will provide a status panel that displays a continuous update of the mission and energy status of any single aircraft specified by the operator.	D	
2.7	Operator Preferences	The operator will be able to set the following aspects of the user interface according to his preference: Numerical units, Symbology used to represent entities, Grid units, and Editing mode for control measures.	D	
2.7		These operator settings can be saved to a file and later retrieved and edited.	D	
2.7		They can be overridden by the operator on a case-by-case basis.	D	
2.7.1	Numerical Units	The operator will be able to choose the units used for the following: distance, altitude, speed, and angles.	D	
2.7.1		Distance -- used for all distance displays, messages, and operator inputs. The available units will be feet, meters, nautical miles, and kilometers.	D	
2.7.1		Altitude -- used for all altitude displays, messages, and operator inputs. The available units will be feet, meters, nautical miles, and kilometers.	D	
2.7.1		Speed -- used for all speed displays, messages, and operator inputs. Available units will include knots, miles per hour, meters per second, mach, and kilometers per hour.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.7.1		Angles -- used for all angle displays, messages, and operator inputs. The available units will include degrees, mils, and radians.	D	
2.7.2	Plan View Display	The operator will be able to select the following: symbology, grid units, and editing mode.	D	
2.7.2		Symbology -- used to represent the entities. The available symbols will include non-military entity icons, Army symbology, and Naval symbology.	D	
2.7.2		Grid units -- used for the map. The available units will include UTM and longitude/latitude. The operator will be able to specify whether to display UTM values in 6-, 8-, or 10-digit format.	D	
2.7.2		Editing mode -- used for control measures. The operator can choose between selecting whole control measures or selecting individual parts of control measures. When whole control measures are selected, operations such as moving and deleting are performed on the entire control measure. When parts are selected, operations are performed only on the part selected.	D	
2.8	Interaction Between Workstations	The SAFstations will have the ability to interact with each other by doing the following: sharing overlays, transferring control, and sharing an exercise time.	I	
2.8		Sharing overlays -- SAFstations will be able to share overlays. A filter will prevent SAFstations on different sides in an exercise from having access to the other side's overlays. Shared overlays can be edited from any SAFstation that has access to them.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
2.8		Transferring control -- Each SAFstation will be able to transfer control of entities and units to any other SAFstation. In Commander mode, the transfer must be initiated from the SAFstation currently controlling the units or entities. In Battlemaster mode, the control of any unit can be transferred to the local SAFstation or to any remote SAFstation.	D	
2.8		Sharing an exercise time -- SAFstations on the same side in the exercise can share an H-Hour.	D	
2.9	Databases	The SAFstations will have access to the DIS, PO, Terrain and Parameter databases, as described in Chapter 5. The DIS database is used to determine the locations, velocities, and physical conditions of entities. The PO Database is used to share command and control as well as system information among the SAFstations, SAFsims, and SAF-loggers.	I	
2.10.1	X/Windows Motif	For maximum portability, the ModSAF graphical user interface will be built using X/Windows and Motif.	I	
2.10.2	DOD User Interface Guide	The ModSAF user interface will be compliant with the draft DOD Human Computer Interface Style Guide, 11 February 1992, prepared by the Common Operating Environment Working Group.	I	
3	SAF Simulator Requirements	ModSAF will provide the SOAR program with the capability to control aircraft movement, sensors, and weapons.	I	
3.1.1	Entity Creation	Each SAFsim will receive creation requests through the Persistent Object database from the SAFstations when the operator requests simulation of SAF entities or units.	D	
3.1.1		All eligible SAFsims on the simulation network will negotiate with each other to decide which SAFsim should simulate that entity.	D	
3.1.1		The selected SAFsim will create and control that entity until told to delete or transfer it.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.1.2	Entity State	The SAFsim will update the DIS and PO databases when the state of the entities it is simulating changes. This information includes the positions, damage level, amount of fuel and ammunition, and marksmanship level.	I	
3.1.3	Entity Deletion	The SAFsim will support the deletion of entities that it is simulating. Only the SAFstation controlling the entity can request its deletion.		N/I
3.1.4	Entity Migration	A SAFsim will transfer simulation of an entity to another SAFsim when requested by the entity's commander.	I	
3.1.4		Each SAFsim will also monitor the state of all other SAFsims on the network.	I	
3.1.4		If a SAFsim drops off the network, the remaining SAFsims will negotiate with each other to take control of the entities being simulated by that SAFsim.	I	
3.1.4		The load will be balanced among the remaining SAFsims to the best possible extent.	I	
3.2	Command Interface	Each SAFsim will check the PO database for actions that its entities are asked to execute.	D	
3.2		The SAFsim will then notify the unit of the presence of the mission, frago, or immediate command and allow the unit to decide how to respond to it.	D	
3.2		The SAFsim will also put subordinate missions generated by its simulated entities in the PO database for execution by the entity's subordinates.	D	
3.2		Missions generated locally will be handled in exactly the same way as remotely generated missions.	D	
3.3	Entity Simulation	The SAF simulation models will emphasize efficiency and avoid simulating those behaviors and mechanisms that do not produce significant externally visible signatures.	I	
3.3		Many SAF models will include simple elements of human control that effectively simplify the behavior of the entities.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3		The SAFsim will allow the construction of new entities either off-line by changing parameter files or, at run time, via the Persistent Object database.	I	
3.3.1	Entity Hull Simulation	The following hull dynamics models will be available: ground vehicle tracked, ground vehicle wheeled, dismounted infantry, fixed wing aircraft, rotary wing aircraft, and missiles.	I	
3.3.1		Specific fuel consumption models will apply to vehicles based on the hull dynamics model.	I	
3.3.1		Vehicles will start with a standard amount of fuel per vehicle, which will be defined in the vehicle parameter database.	I	
3.3.1		Fuel consumption rates will be determined by the specific vehicle dynamic model being used.	I	
3.3.1		Vehicles will consume fuel at rates determined by parameters in the vehicle parameter database.	I	
3.3.1		The fuel consumption rate will be reduced when a vehicle is idling.	I	
3.3.1.1	Ground Vehicles	Ground vehicles will be able to move forward, backward, and turn.	D	
3.3.1.1		Vehicle orientation will be determined by the direction and underlying terrain.	D	
3.3.1.1		Environmental factors, including slope and terrain type, will be considered when moving the vehicle.	D	
3.3.1.1		The following hull dynamics models will be available for ground vehicles: tracked and wheeled.	D	
3.3.1.1		Tracked Ground Vehicles - these vehicles will have the ability to turn in place.	D	
3.3.1.1		Wheeled Ground Vehicles - these vehicles, which have a minimum turn radius, will have to be moving to turn.	D	
3.3.1.2	Dismounted Infantry	The ModSAF system will model dismounted infantry.	D	
3.3.1.2		Each soldier will be able to carry and use a weapon.	D	
3.3.1.2		Infantry will be able to move and turn in place.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.1.2		Infantry will have three postures: standing (either standing in place or moving), kneeling, and prone.	D	
3.3.1.2		Configuration information for infantry will be provided in the vehicle parameter database.	D	
3.3.1.2		Infantry have the special ability to mount other appropriate vehicles, such as IFVs or large helicopters; ride in them to another location; and dismount.	D	
3.3.1.2		While mounted in a vehicle, the infantry will not be visible, but will be vulnerable.	D	
3.3.1.2		Infantry will always be vertical when standing or kneeling.	D	
3.3.1.2		Their orientations when prone will be determined by the underlying terrain.	D	
3.3.1.3	Fixed Wing Aircraft	Fixed wing aircraft (FWA) will have six degrees of freedom.	I	
3.3.1.3		The model will calculate lift, drag, and thrust. Effective limitations on roll, pitch, and yaw rates and accelerations will be enforced.	I	
3.3.1.3		The ModSAF FWA dynamics software will use flight data from Height-Mach (H-M) diagrams to determine the specific power which is available at any point in flight.	I	
3.3.1.3		Flight data from V-N diagrams will be used to enforce aerodynamic and structural limits on lift at any point in the flight envelope.	I	
3.3.1.3		The ModSAF FWA will include a simple low level pilot model that can turn the aircraft to follow a velocity vector, perform level flight, and follow the contour of the earth.	D	
3.3.1.4	Rotary Wing Aircraft	The rotary wing aircraft (RWA) model will have six degrees of freedom.	I	
3.3.1.4		Its effective performance limits will include maximum roll, pitch, and yaw rates, maximum speeds, accelerations, and climb rates. These limits may be expressed in more basic parameters such as maximum lift.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.1.4		The RWA model will include a simple pilot model that is able to follow a velocity vector, perform level flight, contour flight, and nap of earth flight.	D	
3.3.1.5	Missile Entities	The ModSAF system will include the following missile types: (1) ground to ground, (2) Hellfire, (3) long-range, radar guided, air-to-air, (4) medium_range, radar guided, air-to-air, and (5) short-range, IR guided, air-to-air.	D	
3.3.1.5		Ground to ground missiles (similar to the TOW missile) will have a slight superelevation angle and a METHurable initial velocity upon firing. They will fly directly toward the target along a line of sight flight path as long as the line of sight exists between the firing vehicle and the target. They will fly over encroaching terrain, as long as there exists partial line of sight from the firing vehicle to the target. They will be able to coast after the powered portion of the flight is finished.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.1.5		Hellfire Missiles (ground/air to ground) will be fired with a slight superelevation angle. The missile will fly out along its initial trajectory until it finds a lased target point to track to. It will then fly toward the target in the X Y plane, climbing until it achieves a predetermined angle between the direction of travel of the missile and the direct vector to the target point. Maintaining this angle to target slowly pulls the missile flight angle down as the missile approaches the target. When the missile passes into a conical area above the target point, the missile will fly directly at the target point until impact. This missile flight pattern will occur as long as there is a line of sight between the vehicle doing the target designation and the target, and also between the target and the missile. The missile need not be powered during the entire flight. Note, the vehicle that fired the missile does not have to be the vehicle designating the target.	D	
3.3.1.5		Long-Range, Radar Guided, Air-To-Air Missiles (similar to the Phoenix missile) will be launched by the firing vehicle, and will fly straight to the target vehicle using lead pursuit guidance. The firing aircraft will guide the missile. When the target is within the tracking capabilities of the Phoenix missile, the missile will turn on its onboard radar and will track itself to target, independent of its firing aircraft. The firing aircraft must be available to command the missile into self tracking mode. If the firing aircraft is not able to switch the missile to self tracking mode, then the missile will not lock onto a target.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.1.5		Medium-Range, Radar Guided, Air-To-Air Missiles (similar to the Sparrow missile) will fly toward their targets using lead pursuit guidance as long as the firing aircraft has the target illuminated with its radar. A position change by the firing aircraft can cause the missile to lose tracking. An example is a firing aircraft that turns away so that the target is no longer radar illuminated.	D	
3.3.1.5		Short-Range, IR Guided, Air-To-Air Missiles (similar to the Sidewinder) must be locked onto a target before firing. They will fly directly toward a target using pure pursuit guidance as long as there is a line of sight between the missile and the target. Once fired, the missile is self-tracking (IR seeking).	D	
3.3.2	Entity Turret Simulation	The ModSAF system will allow vehicle models to include turrets.	D	
3.3.2		Turrets will be able to rotate, elevate, and depress any mounted weapon to a specified limit.	D	
3.3.2		Turrets will scan to track targets, and when the vehicle is not engaging an enemy, will occasionally scan to a different position within the vehicle's main arc of observation.	D	
3.3.2		Turret parameters (scan rate to a position, scan limits, and the position offset to the attached hull) will be defined in the vehicle parameter database.	D	
3.3.3	Weapons	The weapon systems for each entity will be specified by the parameter database. This specification will include: weapon position on the vehicle, amount of ammunition available to each weapon, pre-fire time delays and weapon fire rates, mount information (turret or hull), and weapon range (area around the vehicle that the weapon can be brought to bear on).	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.3		Weapon types will include missiles (which are visible during flyout and produce direct fire), indirect fire weapons (which are invisible during flight), and direct fire weapons (which are invisible during flight).		
3.3.3		When a direct fire weapon is fired, a hit model will be used to determine if the shell from the weapon will strike the target.	I	
3.3.3		The hit models will take into account the weapon being used, the firer's velocity and range to target, the target's vehicle type, aspect angle, velocity and percent exposure (visibility).	I	
3.3.3		These factors will be used to determine the probability of the shot hitting the target.	I	
3.3.3		This probability will be used to determine if there was a hit or miss.	I	
3.3.3		Each missile will have a specifiable probability that a particular weapon will be a dud.	I	
3.3.3		When a particular weapon is to be used (if the probability is not zero), the chance that this instance of the ammo/weapon will be a dud will be tested.	I	
3.3.3		If it is a dud, there will be no effective impact of the weapon system on the target.	I	
3.3.3		If the dud weapon system carries a warhead or explosive device of some kind, there will be no explosion.	I	
3.3.3.1	Weapon Firing	Turret mounted weapons will require the turret to track and elevate relative to the direction of the target.	D	
3.3.3.1		When appropriate, the weapon system will lead a moving target.	D	
3.3.3.1		Vehicles will stop to shoot if required (for example, the M2 will stop when firing a TOW).	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.3.1		Weapon systems will have the capability to fire at a specific location. Firing may occur even if no particular target vehicle has been specified, or if no potential target vehicle exists at or near the specified location.	D	
3.3.3.2	Tactical Missiles	Missiles will have a parameter file which outlines the performance characteristics of that type of missile.	I	
3.3.3.2		These characteristics will include targeting methods, warhead types, flight dynamics, flight characteristics, sensors, modes, limitations, movement within the dynamics model, etc.	I	
3.3.3.2		Both ballistic and battlefield missiles will be available.	I	
3.3.3.2		Missiles can be targeted and destroyed by weapon systems designed specifically for destroying missiles in flight.	I	
3.3.3.2		Tactical missiles will have the capability of using any of the following guidance algorithms, configured in the parameter files: lead-pursuit, pure lead, and pure pursuit.	I	
3.3.3.2		The weapon specification will also indicate fuzing distance, minimum effective distance for damage, and maximum tracking angle (outside of which target tracking will be lost).	I	
3.3.3.3	Ballistic Missiles	Ballistic missiles will have aspects of their launch sequence user definable.		N/I
3.3.3.3		If the capabilities of the missile provide for the missile to get to the specified point from its launch position, a supplied target point will automatically control the boost phase behavior for the missile.		N/I
3.3.3.3		Parameters that can be specified for ballistic missiles include initial and burnout mass, roll factors (such as angle and start time), thrust, and re-entry characteristics.		N/I
3.3.4	Sensor Simulation	Sensors on each entity will be user specifiable.	I	
3.3.4		Sensor types will include: visual, infrared, and radar.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.4		Parameters appropriate to the sensor type may consist of ranges, update rates, arcs of primary and secondary operation, blind areas, effective distances, and chances of detection.	I	
3.3.4		Sensors will determine what a vehicle can and cannot detect in the environment.	I	
3.3.4		Target entities will be tracked if the following criteria exist: (1) the entity is determined to be within the sensing capabilities of a tracking vehicle, and (2) the target entity passes tests that determine it is detectable.	I	
3.3.4		Probability tables, based on orientation, situation, entity type, line of sight, angle of incidence, etc. may be used to determine target detectability.	I	
3.3.4.1	Radar Model	A radar model will be implemented which calculates the radar cross-section of a target based upon the target type, range to target, and target aspect angle.	I	
3.3.4.1		If the radar cross-section of a target is greater than a threshold based upon the given radar's capabilities and mode, then that target will be detected by the radar.	I	
3.3.4.1		The radar model will implement the following radar modes similar to those in the F-14D AWG-9 radar: Pulse Single Target Track (PSTT), Pulse Doppler Single Target Track (PDSTT), Track-While-Scan (TWS) Manual, and Track-While-Scan (TWS) Auto.	I	
3.3.4.1		The PSTT mode will also be used for the implementation of the long-range missile radar.	I	
3.3.4.1		The radar model will issue the radar protocol data unit (PDU) defined in the DIS standard whenever an aircraft or missile radar is turned on.	I	
3.3.4.1		An interim PDU based on the SIMNET Radar PDU will be used until this PDU is standardized in the DIS Protocol Standards.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.4.2	Visual Model	A visual sensor (eye) model will be provided that takes into account effective target size and occlusion (actual size, aspect angle, range, percentage visible), the eyepoint of the viewer, the probability of detection, and the focus of attention.	I	
3.3.4.2		The models will be easily extended to support different illumination and weather conditions.	I	
3.3.4.3	Infrared (IR) Model	The IR model will be similar to the visual model but will include calculations for IR signature strength instead of effective target size.		N/I
3.3.4.3		Factors for IR signature strength will include thrust levels for aircraft, aspect angle, and entity type.		N/I
3.3.5	Damage	Damage models, which are user specifiable, will define how particular weapons affect a particular entity.	D	
3.3.5		The model will take into account the following factors: angle of incidence of the impact, which component of the target is affected, and the number of rounds taken.	D	
3.3.5		Missiles will be subject to damage by specifically targeted anti-missile systems.	D	
3.3.6	Entity Projections	The following sections list the entity appearances that will be available for projection onto the simulation network.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.6.1	US Entities	The American entities are listed below.	I	
3.3.6.1		A6 A10 ADATS AH-64A B52 CG47 Ch-47 DD963 DI F14D F18 FFG7 AH-1S HMMWV LHD1 LOSAT M1A1 M106A1 M109 M113A2 M113 ambulance M113 engineer M113 M2 M270 M3 M35A2 M577 M88A1 M901 M977 M978 MPQ 53 OH 58C OH 58D UH 60A	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.6.2	Russian Entities	The Threat entities are listed below.	I	
3.3.6.2		BMP 1 BMP 2 DI GAZ 66 MAZ 543 Mi 8 Mi 24 Mi 28 MIG 23 MIG 29 MTLB MTLB ambulance SA 13 SA 9 SU 25 SU refueler T72 T62 T55 UAZ 469 URAL 375F ZIL 157 ZSU 23-4	I	
3.3.6.3	Other Entities	Other entities are listed below.	I	
3.3.6.3		Gazelle LEO 2 MARDER Water Carrier Generic Missile	I	
3.3.7	Entity Behaviors	Behaviors will be decomposed into hierarchical tasks.	I	
3.3.7		Tasks will use entity, environmental, and internal state to generate control inputs that guide the vehicle in accomplishing its mission.	I	
3.3.7.1	Movement	Vehicles and DI will be able to proceed to a point.	D	
3.3.7.1		Given a current orientation, position, and velocity, the vehicles will turn and move toward the goal.	D	
3.3.7.1		Multiple points can be sequenced together to form a route. A route for aircraft will be a simple set of these points.	D	
3.3.7.1		When requested by the operator, a route between two terrain locations can be automatically generated for use by ground units and entities.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.7.1		Ground vehicle routes generated by the system will avoid uncrossable rziver segments.	D	
3.3.7.1		Road routes can be specified by the operator.	D	
3.3.7.1		If a road route is requested, a route consisting of points leading across connecting road segments will be generated.	D	
3.3.7.2	Resupply	Vehicles will have the capability to handle the logistics protocol.		N/I
3.3.7.2		Vehicles will be able to request supplies from a logistics vehicle.		N/I
3.3.7.2		If all resupply conditions are satisfied, logistics vehicles will refuel and rearm at the rates specified by the protocol.		N/I
3.3.7.2		Vehicles may also be resupplied from the SAFstation by the Battlemaster.		N/I
3.3.7.3	Weapon Control	The operator will be able to determine the situations in which a vehicle will be allowed to fire its weapons. Overall fire permission can be withheld.	D	
3.3.7.3		Fire permission can be granted under the following conditions: (1) the target is within a particular distance of the vehicle or (2) the target is within a particular distance of a designated point.	D	
3.3.7.3		Fire permission can also be established so that the vehicle will be limited only by the distance limitations of the weapons systems of that vehicle.	D	
3.3.7.3		Targeting characteristics will allow weapons and targets to be matched in order to select the best target and weapon for the situation based on weapon capabilities, weapon priorities and target type, distance to target, ammunition availability, target priority, and weapon enabled lists.	D	
3.3.7.3		When multiple targets are available for a vehicle, target selection will choose the most appropriate target.	D	
3.3.7.3		The operator will have the ability to establish a target priority list based on a set of vehicle types.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.7.3		This priority list will aid in target selection when multiple targets present themselves.	D	
3.3.7.3		Target classes available will include tanks, command vehicles, APCs, rotary wing aircraft, artillery, anti-aircraft vehicles, logistics vehicles, fixed wing aircraft, missiles, and dismounted infantry.	D	
3.3.7.3		Vehicles with turrets will occasionally scan their turret either through an arc in front of the vehicle or through an arc determined by the vehicle's position in the unit formation. This will only occur when the vehicle is alive and is not firepower disabled.	D	
3.3.7.3		The following commands will be generated for all weapon systems: place the weapon in the correct firing position, fire the weapon, and reload the weapon. Appropriate delay times will be utilized.	D	
3.3.7.3		Aircraft will be able to perform single target beyond visual range (BVR) air to air tactics.	D	
3.3.7.4	Ground Vehicle Specific Control Tasks	Ground vehicles will have the capability to cross bridges.	D	
3.3.7.4		Vehicles will slow down automatically and line up correctly to achieve a successful bridge crossing. After crossing the bridge, vehicles resume their previous speed and formation.	D	
3.3.7.4		Ground vehicles will automatically avoid obstacles they encounter in their paths. Buildings, unfordable river segments, and tree lines (if desired) will automatically be circumvented. Other vehicles will also be avoided. Direction of travel and speed of these vehicles will be taken into account in avoidance calculations.	D	
3.3.7.5	Air Vehicle Specific Control Tasks	The following control tasks are supported for air vehicles.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.7.5		Takeoff And Land Air vehicles will have the ability to take off and land. The aircraft model will handle this task automatically under the following conditions: (1) a vehicle is tasked to move, (2) the overall task the vehicle is performing requires it (such as returning to base to resupply), or (3) the operator issues a request (such as fly to this point and land).	D	
3.3.7.5		Orient Weapon System Air vehicles will have the ability to realistically orient the airframe in a desired direction when required by the targeting requirements of a particular weapon system.	D	
3.3.7.5		Collision Avoidance Other vehicles will be avoided. Direction of travel and speed will be used in avoidance calculations.	D	
3.3.7.5		Bingo Fuel A bingo fuel level will be calculated to determine the time at which an aircraft must end its current mission and return to the refuel point. The distance to a operator specified refuel point will be used in this calculation.	D	
3.3.7.5		Aircraft Resupply When a predetermined level of fuel remains, rotary wing and fixed wing aircraft will automatically perform the appropriate bingo fuel maneuvers, such as returning to base. Rotary wing aircraft will be able to use FARP locations and will do the proper approach, landing, exit, request, and transfer procedures automatically. Fixed wing aircraft will automatically be refueled and rearmed when landing at one of the defined air bases.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.7.5		Orbit Hold Air vehicles will have the ability to perform an orbit hold. Vehicles will perform this task as a single task, as an interrupt to a current task, or as the termination task of other tasks. Given a designated point, the vehicle will begin to circle at a fixed distance from the point at a standard speed.	D	
3.3.7.5		Racetrack Hold Air vehicles will have the ability to perform a racetrack hold. Vehicles will perform this task under the same conditions as an orbit hold. Given a specified point and the direction that the point was approached from, the vehicle will fly to the point, turn around, and head back in the direction it came from. The vehicle will proceed in this direction for a pre-determined time, turn around, and perform the entire maneuver again.	D	
3.3.7.5		Intercept Air vehicles will have the ability to turn and fly a course which will intercept a designated target.	D	
3.3.7.5		Return To Base Air vehicles will have the ability to fly to a point designated as their base of operations. Upon reaching this point, the vehicles will land.	D	
3.3.7.5		Evade Air vehicles will have the ability to turn and fly a course that will attempt to avoid a specific enemy contact or contacts.	D	
3.3.7.6	Fixed Wing Aircraft Specific Control Tasks	The following control tasks are supported for fixed wing aircraft.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.3.7.6		Low-Level Terrain Flight (Automatic Terrain Following) Fixed wing aircraft will have the ability to fly routes close to the ground. In doing so, the vehicle will attempt to maintain the specified required altitude above the ground but will tend to clip peaks and dips. Low level flight will be characterized by a constant speed and a desired average altitude AGL.	D	
3.3.7.6		Takeoff And Land The takeoff and land control task for fixed wing aircraft will be unmodeled. Fixed wing aircraft which are landing will set their altitude and velocity to zero upon achieving correct XY locations in space.	D	
3.3.7.6		Jink Fixed wing aircraft will have the ability to perform sudden changes of flight path. Flight path angle and direction will change. FWA will also be able to fly toward a point while performing multiple jinks.	D	
3.3.7.7	Rotary Wing Aircraft Specific Control Tasks	Contour Flight Rotary wing aircraft will have the ability to fly contour flight. Terrain features lying in the path of the vehicle, such as buildings, trees, and tree canopies, will be flown over before returning to the desired close to ground altitude.	D	
3.3.7.7		Hover Hold Rotary wing aircraft will have the ability to perform a hover hold. This task will be performed under the same conditions as orbit hold. The vehicle will fly to the designated hover point, come to a stop in the air, and remain there.	D	
3.4.1	Minefields	The SAFsim will be able to create and simulate minefields.	D	
3.4.1		These minefields will be specified by a bounding region, the type of mine contained therein, and a density of mines.	D	
3.4.1		Each minefield can have a operator-specified string to identify it.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.4.1		The SAFsim will monitor entities moving within the minefield and probabilistically determine whether a mine explodes.	D	
3.4.1		The minefield will be capable of being breached, and areas where mines have already exploded will not explode again.	D	
3.4.2	Buildings	The system will be able to create buildings in the simulation. Since these buildings are created by the simulation, and are not part of the terrain, they are not permanent. They follow the same rules for creation as entities, except that once created, they can only be destroyed or removed from the simulation.		N/I
3.4.2		A building cannot move, take commands, or perform any sort of activity.		N/I
3.4.3	Damage Simulation	The system can simulate buildings taking damage from direct and indirect fire, and a destroyed building will be displayed under the proper circumstances.		N/I
3.4.3		Damage tables will exist for buildings in the parameter files.		N/I
3.5.1	Unit Types	The types of ground units simulated will include at least the following:	D	
3.5.1		Mechanized infantry battalion, company, and platoon Motorized rifle battalion, company, and platoon Armor battalion, company, and platoon Armored cavalry troop Dismounted infantry section and squad Artillery battery and platoon Supply platoon Mortar platoon Air defense artillery platoon	D	
3.5.1		Air support units will be provided for both fixed-wing aircraft (FWA) and rotary-wing aircraft (RWA) in flights of one, two, three, four, and five aircraft.	D	
3.5.1		Both attack and scout RWA will be provided.	D	
3.5.2	Task Organization	The operator will have the capability to create units composed of entities and/or other units.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.2		The operator will be able to specify the makeup of the units, though some standard units will be available.	D	
3.5.2		It will be possible for the ModSAF system to create its own task-organized units without operator intervention, when tactically appropriate.	D	
3.5.3	Communication	The SAFsim will model message communications between the ModSAF units and their commanders.	D	
3.5.3		Information will be aggregated and messages will be sent to the controlling SAFstation at the level of command of the unit being simulated.	D	
3.5.3		The rate of report will match the battle conditions.	D	
3.5.3		Units will have the ability to collect and correlate vehicle sighting information into spot and contact reports.	D	
3.5.3		Other messages will include artillery impacts, encounters with minefields, unit task transitions, and unit strength reports.	D	
3.5.3		These communication models will also be used to send CVCC protocol packets for shell, contact, status, and spot reports.	D	
3.5.4	Unit Tasks	The grouping of entities into units will allow the operator to control multiple entities by giving commands to the unit as a whole. The unit will then perform the specified commands/tasks as required. These tasks may involve independent actions by sub-units or entities.	I	
3.5.4		Sub-units or entities in a unit may also be directly commanded or tasked separately from the remainder of the unit.	I	
3.5.4		Applicable tasks will support both Threat and US tactics.	I	
3.5.4.1	Ground Unit Tasks	Tasks for ground units will include at least the following:	I	

PARA	TITLE	DESCRIPTION	MTH	TEST
3.5.4.1		**Formation Keeping - Vehicles or DI in a unit will have the ability to move in formation relative to each other. A variety of appropriate formations will be available for each type and size of unit. The commander will be able to set the formation scale factors to adjust the size of the formations. Units will have the capability to automatically adapt their formation to their situation. For example, as a unit arrives at a river bridge, the member vehicles of that unit will fall out of formation as each approaches the bridge, will form a column to cross the bridge, and will return to their original formation on the other side. This behavior will also occur when units skirt terrain features, such as rivers or treelines, or negotiate passages too small to accommodate the original formation.**	D	
3.5.4.1		Command From Simulator - ModSAF ground units will have the ability to be commanded by manned simulators. The manned simulators will take the place of the unit commander vehicle, and will always be the lead vehicle of the unit.	D	
3.5.4.1		Follow Vehicle - ModSAF ground units will have the ability to follow manned simulators. The manned simulators will always be the lead vehicle of the unit.	D	
3.5.4.1		Bounding Overwatch - Ground vehicles and dismounted infantry will be able to perform bounding overwatch movement, in which a portion of the unit covers the movement of another portion of the unit, using terrain features as cover.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.4.1		Targeting Coordination - Vehicles in a unit will have the capability to coordinate their fire with multiple targets. For example, a US tank platoon of M1s presented with multiple targets will each shoot at a target that has not already been chosen by another member of the platoon. This will occur only with units that do this sort of coordinated fire (i.e., US units), and only at the basic platoon level.	D	
3.5.4.1		Hasty Attack - Ground units will automatically perform a hasty attack when they come under fire, have fire permission, and are on the move.	D	
3.5.4.2	Air Unit Tasks	Tasks for air units will include at least the following:	I	
3.5.4.2		Formation Keeping - Vehicles in a unit will have the ability to move in formation relative to each other. A variety of appropriate formations will be available for each type and size of unit.	D	
3.5.4.2		Targeting Coordination - Vehicles in a unit will have the capability to coordinate their fire at multiple targets. This will occur only with units at the basic flight level.	D	
3.5.4.2		FWA Ground Attack - FWA units will have a standard set of ground attacks available, with a variety of operator-selectable options. The unit will perform an ingress using any method and formation normally available for route following. The flight will then do one of the following actions: go straight to the target area in a direct attack, spread out into a line and do a trailing attack, or split up and do either a split or a ninety/ten attack. Attack entry points can also be selected as either level or pop-up attacks, or standoff pop-up and dive attacks. Available delivery methods for the attack will be laydown, strafe, medium-altitude dive, or low-altitude dive.		N/I

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.4.2		RWA Ground Attack - RWA units will have two predefined ground attack patterns, hover-fire and running-fire. For both, the aircraft will approach the target area slowly at very low altitude to avoid detection. In a hover-fire attack, the vehicles move into (or approach in) an extended line formation. Each aircraft will then pop up until a target is acquired, fire at that target, move back down, then move laterally and pop up and fire again. This will continue until all targets in the designated area have been destroyed. In a running-fire attack, the rotary wing aircraft will move to attack speed, flying straight toward the target area, fire, and then retreat. Each aircraft will either make the run once only or make multiple runs, as specified by the commander.	D	
3.5.5	Unit Task Frames	The user will create missions for the units he controls by combining and editing sequences of task frames. Unit task frames will be created from unit tasks. This section lists the unit task frames that will be defined in the ModSAF system.	I	
3.5.5		The operator will select generic task frames; the specific task frames that will be executed are determined by the unit (echelon and tactics. i.e. US or Threat) that they are assigned to. Some task frames will not apply to all units.	I	
3.5.5		The tasks that compose a task frame have many parameters with default settings. The user customizes the task frames that he uses by editing these parameters, which include speeds, formations, messages, rules of engagement, etc.	I	
3.5.5.1	Ground Unit Task Frames	Ground Unit task frames components will include:	I	

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.5.1		Assault/Attack Clear Area Halt Occupy Ambush Hasty Attack/Action Drill Occupy Assembly Area Occupy Battle Position Pre-battle March Random Traffic Reconnoiter Roadmarch Tactical March Withdraw	I	
3.5.5.2	Rotary Wing Aircraft (RWA) Task Frames	The ModSAF software will be capable of performing the following task frames for RWA units:	I	
3.5.5.2		Occupy Assembly Area - A unit will fly to the center of an area and land in an occupy assembly area formation. This formation maximizes the chance of detecting enemy contact from any direction, and the chance of escape of some of the unit if surprised.		N/I
3.5.5.2		Occupy Battle Position - A unit will fly to a position and hold in an occupy battle position formation. The battle position formation allows mutual support and early detection of any enemy contact. The direction of expected contact will be the orientation of the formation.		N/I
3.5.5.2		Fly Enroute - A unit will fly along a route, with one particular vehicle following the route, and the other vehicles in the unit maintaining predetermined formation positions relative to the leading vehicle or each other.	D	
3.5.5.2		Aerial Fire Support/Close Air Support - Units will fire at ground targets in a designated area.	D	
3.5.5.2		Return To Base - Rotary wing aircraft units will have the ability to fly to a point designated as their base of operations. Upon reaching this point, the vehicles will land.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.5.2		FARP Behavior - Rotary wing units will have the ability to perform the proper FARP behaviors. The unit will fly to a point a few kilometers from the resupply point, then drop down to a low altitude, and fly nap of earth or low level flight to the resupply point. The aircraft will automatically query the vehicles in the supply area for needed supplies, and will land and perform the resupply procedures. When done, vehicles will leave the area, again using low level or nap of earth flight till they are again a few kilometers from the resupply area.		N/I
3.5.5.2		Hold - RWA units will have the ability to do hover, orbit, and racetrack holds. Hover holds will be accomplished by the leader coming to a stop at a particular location, and the rest of the unit moving into proper formation positions relative to the leader and each other. For an orbit hold, the vehicles will trail the lead vehicle as they move around the orbit circle. For the racetrack hold, vehicles will maintain formation positions, and will follow the lead vehicle around the racetrack route as if following the lead vehicle on a normal route.	D	
3.5.5.3	Fixed Wing Aircraft (FWA) Task Frames	The ModSAF software will be capable of performing the following task frames for FWA units:	I	
3.5.5.3		At Airport - Aircraft will remain on the ground and will not move. Vehicles will be resupplied while performing this mission.	D	
3.5.5.3		Ingress - Unit will follow a route into a target area. Targets of opportunity should not be approached. This should be used before an Attack Ground Targets mission.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.5.3		Attack Ground Targets - The unit will perform the appropriate predetermined ground attack tasks, chaining together approach, entry, delivery, and egress. The proper (but not required) mission to approach an attack target ground mission is an ingress, and if used, the unit will proceed to an egress mission when the attack is finished. For options, see Air Unit Tasks, FWA Ground Attack.		N/I
3.5.5.3		Egress - Unit will follow a route out of a target area. Targets of opportunity can be approached. This should be used after an Attack Ground Targets mission.	D	
3.5.5.3		Fly Enroute - Unit will fly along a route, with the lead vehicle following the route, and the other members of the unit stationkeeping off the leader or each other as appropriate.	D	
3.5.5.3		Combat Air Patrol - The unit will patrol an area, awaiting orders or targets of opportunity.	D	
3.5.5.3		Hold - FWA units will have the ability to do orbit and racetrack holds. Orbit holds will be accomplished by the vehicles trailing the lead vehicle as they move around the orbit circle. For racetrack holds, vehicles will maintain formation positions and follow the lead vehicle around the racetrack route as if following the lead vehicle on a normal route.	D	
3.5.6	Unit Reactions	The SAFsim will implement automatic reactive behaviors. ModSAF vehicles of different types will have unique sets of reactive behaviors for different situations and battlefield events. Reactions will be in addition to tasked behaviors. Reactions will include, but not be limited to the behaviors listed below.	I	
3.5.6.1	Ground Unit Reactions	The ground unit reactions will include the following:	I	
3.5.6.1		Action Drill / Hasty Attack - Triggered by contact with enemy units of appropriate size, position, and activity when the unit has permission to engage.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.6.1		Hasty Withdraw - This reaction will occur when the unit has no fire permission and comes under fire from another unit.		N/I
3.5.6.1		React To Air Raid - The unit reacts when taking fire from an enemy aircraft and not attacking. The unit will scatter and vehicles will take cover if it is available.		N/I
3.5.6.1		Avoid Enemy Contact (while covered or in open) - The unit will try to find a place to hide, or if already hidden, will remain in place until the air contact is broken.		N/I
3.5.6.1		Withdraw from Minefield - Triggered when a unit encounters a mine. The unit,assuming a tank trap, may issue covering fire and then back out of the minefield until covered from potential fire by intervening terrain or by terrain features such as trees or buildings.	D	
3.5.6.1		React to Artillery - Unit will seek cover.	D	
3.5.6.2	Rotary Wing Aircraft (RWA) Reactions	The following reactions will be included for ModSAF RWA:	D	
3.5.6.2		React To Enemy FWA Attack - Unit will turn into the approaching enemy FWA and then fly as fast and as low as possible in order to cut their firing angles. Once behind the enemy FWA, the surviving RWA will turn around and fire on the enemy aircraft.		N/I
3.5.6.2		React To Enemy RWA Attack - RWA in the unit will scatter in the opposite direction of the attacking aircraft, and will rendezvous at a distance from the initial position.		N/I
3.5.6.2		Evade - The unit will turn away from the air defense unit and get as low as possible, flying away from the fire or radar. At a safe distance, the unit will regroup and either Hold Awaiting Instructions or resume its mission.		N/I

PARA	TITLE	DESCRIPTION	METH	TEST
3.5.6.2		Bingo Fuel - The vehicle will monitor its fuel load and the distance from base or refuel location. If the critical fuel level is reached, the vehicle will return to base.	D	
3.5.6.3	Fixed Wing Aircraft (FWA) Reactions	The ModSAF software will be capable of performing the following FWA reactions:	D	
3.5.6.3		Bingo Fuel - The vehicle will monitor its fuel load and the distance from base or refuel location. If the critical fuel level is reached, the vehicle will return to base.	D	
3.5.6.3		Evade - The unit will turn away from the air defense unit and fly away from the fire or radar. If enemy fire is shell fire, the unit will try to gain altitude. At a safe distance, the unit will regroup, and either Hold Awaiting Instructions or resume its mission.		N/I
3.6	Parser Interface	The SAFsim will provide a parser interface with the following capabilities for testing SAF software:	D	
3.6		a limited set of command line instructions for controlling the ModSAF system and vehicle debugging	D	
3.6		the capability to turn debugging code on and off in the SAFsim	D	
3.6		the capability to query the status of executing tasks and units in the simulation exercise	D	
3.7	Database Interfaces	The SAFsim will obtain information from the following databases: Terrain Database, Persistent Object Database, DIS Database, and Parameter Database. These databases are described in Chapter 5.	I	
4.1	Graphical User Interface (GUI)	The ModSAF data logger will provide a GUI for user interaction. The GUI will use X/Windows and Motif, and provide access to all features that the data logger supports.	I	

PARA	TITLE	DESCRIPTION	METH	TEST
4.2	Exercise Recording	The ModSAF data logger will be able to record the simulation packets of any protocol family transmitted on the simulation network. These include the DIS, Persistent Object (PO), SIMNET, and Data Collection protocols. The GUI will allow the user to select which protocol families to record. It will also allow the user to specify the exercise ID, exercise start time and date, and the file name under which the exercise will be saved. A compact data storage format will be used, so that large-scale exercises that last many hours can be recorded into a single file. The data will be recorded in such a way as to allow random access into the recorded exercise.	D	
4.2		The ModSAF data logger will display exercise statistics on the GUI in real time while an exercise is being recorded. These statistics will include the exercise packet rate, exercise entity count, logger data file size, and elapsed exercise time.	D	
4.2		The ModSAF data logger will support a studio mode that allows recording into multiple logger files simultaneously, playback of multiple logger files simultaneously, and editing and splicing of logger files.	D	
4.2		The ModSAF data logger will provide an automatic shut-off feature that can be used to stop recording or playback at a user-specified time. This will have the same effect as pressing the "stop" button at the specified time.	D	
4.3	Exercise Playback	The ModSAF data logger will be able to play back the simulation packets of any protocol family recorded in a ModSAF data logger file. These include the DIS, Persistent Object (PO), SIMNET, and Data Collection protocols. The GUI will allow the user to select which protocol families to play back.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
4.3		The ModSAF data logger will display exercise statistics on the GUI in real time while an exercise is being played back. These statistics will include the exercise packet rate, exercise entity count, logger entity tick rate, elapsed exercise time, and remaining exercise time.	D	
4.3		The ModSAF data logger will be able to play back a data logger file on any exercise ID, regardless of the exercise ID on which the file was recorded. The ModSAF data logger will support modification of entity simulation IDs, so that multiple exercises can be played back simultaneously without interference.	D	
4.3		The ModSAF data logger will be able to play back in forward and reverse directions. The ModSAF data logger will be able to play back an exercise either in real time, up to 50 times faster than real time, or up to 10 times slower than real time. It will compensate for first order dead reckoning of entities so that they appear to move smoothly even when being played back at speeds other than real time.	D	
4.3		The ModSAF data logger will be able to make an exercise pause during playback without causing the entities to time out on the simulation network. The ModSAF data logger will be able to play back a user-specified portion of an exercise repeatedly (loop play).	D	
4.4	Initialization of ModSAF from a Logged Exercise	Since all ModSAF command and control information is sent via the PO protocol, the ModSAF data logger will be recording the state of the missions that ModSAF entities are executing throughout an exercise. The ModSAF data logger will record PO protocol packets in such a way as to allow initialization of ModSAF from any point in a logged exercise. The recording will not interfere with the normal operation of the simulation.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
4.4		The ModSAF data logger will provide an interface for generating a ModSAF scenario file at any point during playback. The scenario file generated can then be used to initialize ModSAF entities from that point in the exercise. This interface will allow ModSAF entities to be initialized from any point in the exercise without having to replay the entire exercise up to that point.	D	
5.1	DIS Database Interface	The ModSAF software will support the DIS 1.0 protocol, with appropriate extensions necessary for ModSAF, such as radar packets. All applicable DIS packets (entity state, events, exercise control, appearance, impact, status, etc.) will be supported. In accordance with the DIS standard, each entity will broadcast state at least once every five seconds, and more often if required by dead reckoning algorithms. The DIS network interface layers will be UDP/IP.	D	
5.1		The ModSAF software will also support the SIMNET 6.6.1 protocol using the SIMNET association layer as the network interface layer.	D	
5.1		The network drivers will be in a small, well-defined interface module to enhance portability across operating systems and computers.	D	
5.2	PO Database Interface	The following requirements apply to the Persistent Object (PO) database:	I	
5.2		It will support large numbers of hosts.	D	
5.2		It will support real-time performance.	D	
5.2		It will be able to recover from missed packets.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
5.2		It will support migration of simulation objects from one simulation computer to another. It will be possible for simulation objects to migrate at the user's command. It will be possible for simulation objects to migrate automatically during simulation and entity creation, either for load balancing or graceful recovery when a simulator times out.	D	
5.2		It will support thousands of database objects that change infrequently (less than two or three times per minute). Objects will rebroadcast with a 30-second timeout period for an initial period. Source-based filtering will be used to reduce steady-state packet rates.	D	
5.2		It will support query-driven and event-driven interfaces.	D	
5.2.1	Command and Control	The PO database will support representations of order of battle information, orders including missions and graphics, intelligence, reports and messages, H-hours, and other information required to set up exercises and control their participants.	D	
5.2.2	Command and Control Overlays	The capability to organize command or exercise information into overlays and share that information between workstations will be provided. These overlays will store unit and entity locations, unit and entity missions, possible enemy locations and other intelligence information, and mission-specific information (including graphics and routes). Sharing of overlays will be possible only among workstations playing on the same side in an exercise.	D	

PARA	TITLE	DESCRIPTION	METH	TEST
5.3	Parameter Database Interface	System and performance parameters will be defined in public parameter files, which will be used to initiate a runtime parameter database. This database can be changed at runtime by the user or the system, and will allow modification of models without recompiling source code. The types of parameters defined in the public files are described below.	D	
5.3.1	Organiz-ational Parameters	The organizational parameters will define the organic echelons and formations used by the SAF units. These echelons can be grouped to define new unit types.	D	
5.3.2	Entity Parameters	The entity parameters will specify characteristics of SAF entities and define the component physical models and weapons systems for each SAF entity. The network entity types are defined in the simulation protocol files, but variations of these entities can be created in the parameter files. The following entity information can be specified in these files:	I	
5.3.2		Network representation Alignment, identity, and function of entity Weapons carried by entity Dynamics model parameters Damage models for direct and indirect weapons Standard fuel and ammunition loads Detection probabilities	I	
5.3.3	Weapon Parameters	The weapon parameter files will specify characteristics of different weapons systems. The following weapon system information can be specified in these files:	I	
5.3.3		Characteristics of projectile weapons (munition, range, round velocity, mass)	I	
5.3.3		Characteristics of missiles (acceleration, maximum speed, maximum range, guidance model, default elevation, mass, dud probability)	I	
5.3.3		Hit probabilities		

PARA	TITLE	DESCRIPTION	METH	TEST
5.3.4	Behavioral Parameters	The behavioral parameter files will define parameters for the various behavioral tasks, specializing them for different units and situations. Tasks and their parameters will also be organized into task frames to define tactics and mission components.	I	
5.3.5	User Interface Parameters	The user interface parameter files will define parameters for the user interface. These will include:	I	
5.3.5		Unit icons and entity pictures	I	
5.3.5		Graphics attributes (color, line types)	I	
5.3.5		Size of panes for map, messages, and editor	I	
5.3.5		Control Measures	I	
5.3.5		Coordinate conversion	I	
5.3.6	Sensor Parameters	The sensor parameter files will define the parameters for the various sensor systems modeled in ModSAF. These will include:	I	
5.3.6		Type of sensor	I	
5.3.6		Capabilities of sensor	I	
5.3.7	Exercise Parameters	The exercise parameter files define parameters used to control the ModSAF system in the context of a simulation site. This includes the site/host information for each SAF component.	I	
5.4	Terrain Database Interface	The terrain databases will support the following queries:	I	
5.4		Intervisibility, including point-to-point and area intervisibility	D	
5.4		Terrain elevation cross section	D	
5.4		Elevation and orientation for entity placement	D	
5.4		Soil type	D	
5.4		Coordinate conversion between UTM, latitude/longitude, earth-centered Cartesian and local coordinates	D	
5.4		Basic terrain feature data and attributes, including roads, rivers, buildings, lakes, and trees	D	
5.4		Road and river networks	D	
5.4		Local terrain features for terrain reasoning	D	

PARA	TITLE	DESCRIPTION	METH	TEST
5.4		While multiple databases may be used at runtime for different purposes, they will all be automatically generated from a single common source file to ensure correlation.	D	
5.4.1	Terrain Data	The terrain database will include the soil types (road, muck, deep water, shallow water, packed dirt, soft dirt, sand, forested, etc.) at each point. Altitude and slopes will be included. While a regular grid system may be used, it will also be possible to describe and use irregular grids of larger or smaller size ("microterrain").	D	
5.4.2	Cultural Data	The terrain database will be capable of representing at least the following cultural data: primary roads, secondary roads, bridges, railroads, buildings.	D	

APPENDIX B

Glossary of Acronyms and Abbreviations

ARPA	Advanced Research Projects Agency
ATP	Acceptance Test Plan
AVTB	Aviation Test Bed, Ft. Rucker, Alabama
BDS-D	Battlefield Distributed Simulation - Developmental
CGF	Computer Generated Forces
LADS	Loral Advanced Distributed Simulation
CDRL	Contract Data Requirements List
MWTB	Mounted Warfare Test Bed, Ft. Knox, Kentucky
DI	Dismounted Infantry
DIS	Distributed Interactive Simulation
GUI	Graphical User Interface
ModSAF	Modular Semi-Automated Forces
SAF	Semi-Automated Forces
SAFOR	Semi-Automated Forces
SAFsim	ModSAF Simulator Subsystem
SAFstation	ModSAF user interface workstation
SPR	Software Problem Report
SOW	Statement of Work
WISSARD	What If Simulation System for Advanced Research and Development